HIGH DESERT
POWER PROJECT LLC

March 10, 2006

Mr. Steve Munro
Compliance Project Manager
California Energy Commission
1516 9th Street, MS 2000
Sacramento, CA 95814-5512

Subject: **Addendum 1**
Petition for Revisions/Administrative Changes to Soil & Water - 4
Commission Decision (97-AFC-1C)
High Desert Power Project, LLC

Dear Mr. Munro:

High Desert Power Project (HDPP) is enclosing the following information as an addendum to the subject petition submitted for approval on September 30, 2005:

- Additional information to support the requested extension (Attachment A);
- Brief description of other alternatives currently being evaluated by HDPP to address the current ABS issues and expedite banking (Attachment B). The information in Attachment B is not the basis for the petition for extension and is included as information only. As discussed, HDPP will update the CEC as we make progress on the evaluation of the alternatives and if any of the listed alternatives is more appropriate to address the ABS issues and expedite banking; and
- Schedule to complete evaluation of alternatives (Attachment C).

As detailed in Attachment A, HDPP is requesting an extension until January 1, 2016 to meet the current ground water injection requirement (13,000 AF) based on the following and other assumptions listed in attachment A:

- current annual average treatment levels for Total Dissolved Solids (TDS) and Trihalomethanes (THM);
- installation of UV disinfection system to minimize THM formation and allow HDPP to meet the current THM annual average treatment level of 0.5 ug/L; and
- net annual injection rate of 1,148 AF/yr.

As demonstrated in the original petition, the proposed revisions

- will not result in an adverse impact to the groundwater quality;
- will allow HDPP more flexibility to (i) continue minimizing aquifer impact during periods of elevated TDS and (ii) meet the current ground water injection requirement of 13,000 acre-feet.
- do not affect compliance with applicable laws, ordinances, regulations, or standards (LORS).

Accordingly, HDPP requests the Energy Commission Staff to expedite review of this petition, and request Commission approval of the proposed revisions in accordance with Title 20 CCR §1769(a)(3).

Per our conversations, in an effort to expedite the approval of the extension, HDPP is planning on scheduling a meeting with you and others at the CEC during the week of February 27, 2006 to review and answer any questions you may have on this submittal.

In the meantime, should you have any questions or need additional information, please contact me at (949) 425-4755.

Sincerely,

R. Garcia R.

Ramiro R. Garcia
Environmental Director – West Region
Constellation Energy

Attachments

cc: Mr. Greg Cash
RWQCB – Lahontan Region
14440 Civic Drive, Suite 200
Victorville, CA 92392-2306.

Steve Gross, Constellation Energy
Dave Boward, HDPP
Steve Shulder, Constellation Energy
Jon Boyer, HDPP
Facility File: 2.1.11 (ABS Correspondence)

Attachment A

Additional Information to Support Requested Extension

Per Soil & Water 4 of the CEC Decision, HDPP is required to inject 13,000 acre-feet (AF) into the aquifer over the first five years of commercial operation. As of December 31, 2005, HDPP has injected approximately 2,706 acre-feet. As detailed below, HDPP is requesting an extension until January 1, 2016 to meet the current ground water injection requirement of 13,000 acre-feet (AF).

Below are the assumptions and calculations of the additional years to achieve a net injection of 13,000 AF.

Assumptions

- Current treatment levels for TDS and THM
- Installation of UV disinfection system to minimize THM formation and allow HDPP to meet the current THM annual average treatment level of 0.5 ug/L
- ABS can operate 40 % of the time per year after the UV system has been installed. The 40 % is based on the average TDS levels from 1989 to 2004. It will take about 44 weeks to install the UV system after approval of petition. See UV System Description and Installation Schedule in Attachment A. Therefore, will assume only three months of operation for the rest of 2006 and 40 % of the time starting in 2007.
- 0.5 % Water Dissipation (Loss) thru end of 2005 (Based on Modeling Results)
- 1.0 % Water Dissipation (Loss) Rate after 2005 (Based on HDPP Projection)
- Water banked as of 12/31/05 = 2,706 AF
- Design injection flow rate= 2,150 gal/min = 9.5 AF/day
- Aquifer Banking System Capacity Factor = 85% (expected injection system operating rate)
- Extraction for well testing and development - 12 AF per year (Based On Past System Operation)
- Extraction to support Plant operation. Approximately 19 AF/yr calculated as 13.25 AF/day * 7 days / 5 years. Aqueduct is shutdown for maintenance for approximately 7 days once every five years. This represents the total volume of make-up cooling water needed during the 7 days when the SWP water is not available to HDPP, prorated over the 5 year period between maintenance downtimes.

Calculations

Net Water Banked as of 12/31/05

Net banked thru 2004 as calculated by the CEC = 1, 924 AF
Net banked in 2005 @ 0.5 % loss = 763.3 AF

=> Net water banked as of 12/31/05 = 2,687.3 AF

Estimated Net Water Banking for 2006

= (Design Injection Flow Rate, AF/day) * (Injection Capacity factor, %) * (90 days) – (extraction to support plant operation and well development) – (water dissipation @ 1.0 % loss/year)
= (9.5 AF/day) * (0.85) * (90 days) – (12 AF + 19 AF) – water dissipation @ 1 %
= 695 AF

Estimated Net Water Banked thru 2006

= (Water Banked thru 2005 + Estimate for 2006)
= 2,687.3 AF + 695 AF
= 3,382 AF

Net Annual Injection (excluding dissipation)

= (Design Injection Flow Rate, AF/day) * (Injection Capacity factor, %) * (365 days/yr) * (% Injection) – (extraction to support plant operation and well development)
= (9.5 AF/day) * (85 %) * (365 days/yr) * (40 %) – (12 AF + 19 AF)
= 1,148 AF/yr

Additional Years Required to Bank 13,000 AF after January 1, 2007.

Year	Year Start Volume	End of Year Loss	Quantity Injected During Year	End of Year Volume
	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)
1	3,382	34	1,148	4,496
2	4,496	45	1,148	5,599
3	5,599	56	1,148	6,691
4	6,691	67	1,148	7,772
5	7,772	78	1,148	8,843
6	8,843	88	1,148	9,902
7	9,902	99	1,148	10,951
8	10,951	110	1,148	11,990
9	11,990	120	1,148	13,018

Attachment A

Attachment A

Additional Information to Support Requested Extension

Per Soil & Water 4 of the CEC Decision, HDPP is required to inject 13,000 acre-feet (AF) into the aquifer over the first five years of commercial operation. As of December 31, 2005, HDPP has injected approximately 2,706 acre-feet. As detailed below, HDPP is requesting an extension until January 1, 2016 to meet the current ground water injection requirement of 13,000 acre-feet (AF).

Below are the assumptions and calculations of the additional years to achieve a net injection of 13,000 AF.

Assumptions

- Current treatment levels for TDS and THM
- Installation of UV disinfection system to minimize THM formation and allow HDPP to meet the current THM annual average treatment level of 0.5 ug/L
- ABS can operate 40 % of the time per year after the UV system has been installed. The 40 % is based on the average TDS levels from 1989 to 2004. It will take about 44 weeks to install the UV system after approval of petition. See UV System Description and Installation Schedule in Attachment A. Therefore, will assume only three months of operation for the rest of 2006 and 40 % of the time starting in 2007.
- 0.5 % Water Dissipation (Loss) thru end of 2005 (Based on Modeling Results)
- 1.0 % Water Dissipation (Loss) Rate after 2005 (Based on HDPP Projection)
- Water banked as of 12/31/05 = 2,706 AF
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- Aquifer Banking System Capacity Factor = 85% (expected injection system operating rate)
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- Extraction to support Plant operation. Approximately 19 AF/yr calculated as 13.25 AF/day * 7 days / 5 years. Aqueduct is shutdown for maintenance for approximately 7 days once every five years. This represents the total volume of make-up cooling water needed during the 7 days when the SWP water is not available to HDPP, prorated over the 5 year period between maintenance downtimes.

Calculations

Net Water Banked as of 12/31/05

Net banked thru 2004 as calculated by the CEC = 1, 924 AF
Net banked in 2005 @ 0.5 % loss = 763.3 AF

=> Net water banked as of 12/31/05 = 2,687.3 AF

Estimated Net Water Banking for 2006

= (Design Injection Flow Rate, AF/day) * (Injection Capacity factor, %) * (90 days) – (extraction to support plant operation and well development) – (water dissipation @ 1.0 % loss/year)
= (9.5 AF/day) * (0.85) * (90 days) – (12 AF + 19 AF) – water dissipation @ 1 %
= 695 AF

Estimated Net Water Banked thru 2006

= (Water Banked thru 2005 + Estimate for 2006)
= 2,687.3 AF + 695 AF
= 3,382 AF

Net Annual Injection

= (Design Injection Flow Rate, AF/day) * (Injection Capacity factor, %) * (365 days/yr) * (% Injection)
= (9.5 AF/day) * (85 %) * (365 days/yr) * (40 %)
= 1,179 AF/yr

Additional Years Required to Bank 13,000 AF after January 1, 2007.

Year	Year Start Volume	End of Year Loss	Quantity Injected During Year	End of Year Volume
	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)
1	3,382	34	1,149	4,497
2	4,497	45	1,149	5,601
3	5,601	56	1,149	6,694
4	6,694	67	1,149	7,776
5	7,776	78	1,149	8,847
6	8,847	88	1,149	9,908
7	9,908	99	1,149	10,958
8	10,958	110	1,149	11,997
9	**11,997**	**120**	**1,149**	**13,026**

Sentinel UV Disinfection System

The UV system will be used to maintain cleanliness of the injection pipeline system without chloramination treatment. UV systems are designed to destroy cryptosporidium and other bacteria, viruses, and protozoa. The ultraviolet (UV) system that is being considered for use is a Sentinel UV system designed by Calgon Corporation. Calgon Carbon Corporation research discovered that low UV levels could be used to prevent the parasites from replicating. The company was granted a patent for using the process to destroy cryptosporidium in drinking water using UV light.

The Sentinel UV disinfection system consists of a flow-through reactor with quartz tubes. It utilizes proprietary high-powered, medium-pressure UV lamps (up to 30kW) to emit high-energy UV radiation through a quartz sleeve into the water to be treated. UV sensors are used to ensure that adequate UV doses are being applied. The system utilizes a paired system of primary lamps/back-up lamps which automatically start if a primary lamp extinguishes.

See enclosed vendor information at the end of this attachment for additional details on the Sentinel UV system and list of some of the facilities currently using the system.

Specification

HDPP will install an 18" diameter Sentinel UV disinfection system on the discharge pipe of the VVWD booster pump station. The system provides greater than a three log (99.999 %) reduction of cryptosporidium using high intensity-medium pressure lamps that produce no byproducts.

Estimated Schedule

Task	Duration
System Design	4 Weeks
Site Survey	4 Weeks
Equipment Specification	2 Weeks
Project Justification and Approval	4 Weeks
Procurement	4 Weeks
Manufacture and Delivery	20 Weeks
Installation	4 Weeks
Start-up and Testing	2 Weeks
Project Duration	44 Weeks

UV System Vendor Information

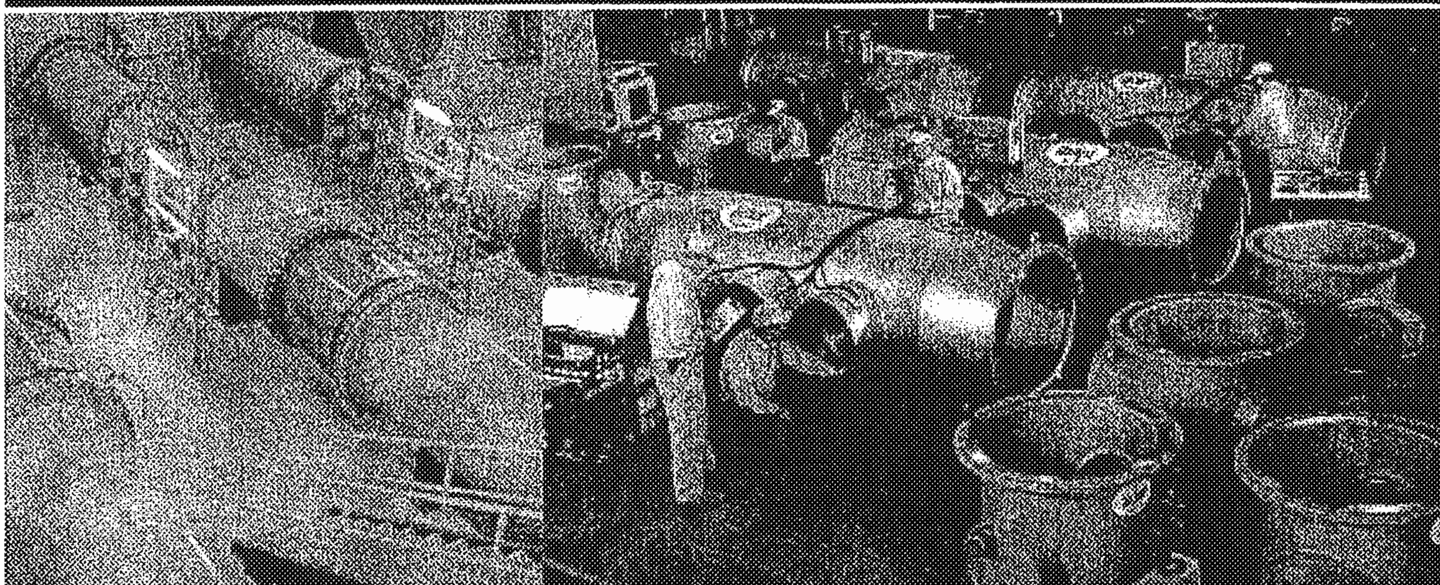
SENTINEL® UV Disinfection Systems

CALGON

CALGON CARBON CORPORATION

UV Technologies Division

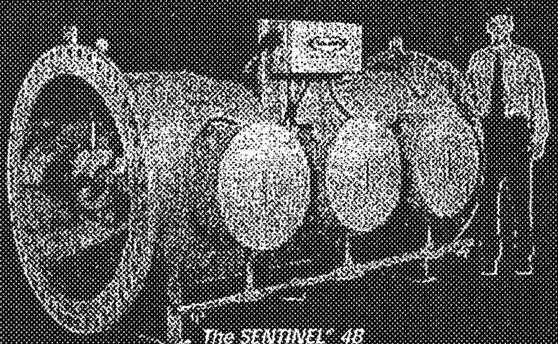
Making Water and Air Safer and Cleaner



SENTINEL®
UV Disinfection Systems

The SENTINEL® system offers many unmatched advantages:

- LOW COST. Medium-pressure UV technology achieves a > 3 log inactivation of *Cryptosporidium* for pennies per 1,000 gallons.
- PROVEN EFFECTIVE. NSF/EPA verified and third-party validated under the new EPA Long Term 2 Enhanced Surface Water Treatment Rule in the United States.
- FLEXIBLE DESIGN. Multiple sizes can be retrofitted easily into existing systems. We currently have four validated reactor systems - 12", 18", 36", and 48" - handling from < 1 mgd up to 40 mgd per reactor.
- CLEAN. No disinfection by-products.
- SAFE. Automatic shutdown for operator safety.



The SENTINEL® 48
Validated to treat up to 40 mgd (the highest flow in the industry)

Calgon Carbon's UV Technology Leadership and Experience

Calgon Carbon's UV Technologies Division has over 350 systems and 20,000 kW of medium-pressure lamps installed for treating a broad spectrum of contaminated groundwater, wastewater, process water, and drinking water.

A large base of SENTINEL® drinking water systems treating from 1 to 100 mgd has been installed since 1999. In addition, SENTINEL® has met the requirements of third-party validation testing in both Europe and North America.

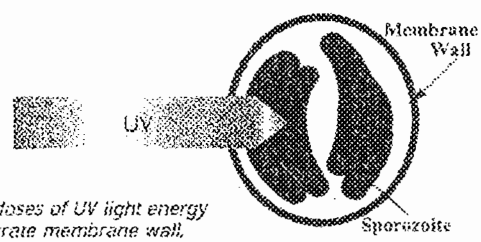
SENTINEL® UV Disinfection

Calgon Carbon's SENTINEL® UV Disinfection systems represent a significant breakthrough in the disinfection of drinking water supplies. With the commercialization of SENTINEL® in 1999, UV disinfection became an effective, reliable barrier against viruses, bacteria, and parasites such as *Giardia* and *Cryptosporidium* at a fraction of the cost of other treatment technologies.

Cryptosporidium and *Giardia*, microscopic parasites present in almost all surface waters, are highly resistant to traditional treatment methods such as chlorination. When ingested through drinking water, they can cause illness characterized by severe abdominal cramps and diarrhea. This illness can be fatal in individuals with suppressed immune systems.

Until a few years ago, UV disinfection was not considered cost-effective for controlling *Cryptosporidium* and *Giardia* cysts and oocysts. Pioneering research, launched and funded by Calgon Carbon Corporation , contradicted all previous tests on the merits of using UV to protect drinking water. This lead to an inventive process for inactivating these organisms and rendering them non-pathogenic. In 1998, this inventive process was accorded both U.S. and foreign patents (U.S. Patent Numbers 6,129,893 and 6,565,803) and is the heart of all SENTINEL® UV systems.

Calgon Carbon's patented process provides better than 99.99% inactivation of both *Cryptosporidium* and *Giardia* at UV doses of less than 10 mJ/cm². In addition to inactivating *Cryptosporidium*, SENTINEL® systems also inactivate *E. coli*, *Giardia*, *rotavirus*, and other pathogens.



Low doses of UV light energy penetrate membrane wall, rendering pathogens harmless.

Over the past several years, Calgon Carbon has obtained additional validation for its other models of SENTINEL® UV systems through independent third parties such as the Portland Validation Center operated in the U.S. and the German DVGW. Calgon Carbon Corporation has the highest flow UV reactor (40 mgd) validated under the U.S. EPA Disinfection Guidance Manual.

About UV Oxidation and Disinfection

The Ultraviolet Light Process
In the UV process, proprietary high-powered, medium-pressure ultraviolet lamps (up to 30 kW) emit high-energy UV radiation through a quartz sleeve into contaminated groundwater, wastewater, drinking water, or process water.

Hydrogen peroxide is added to the contaminated water and is then activated by the UV light to form hydroxyl radicals, which oxidize dissolved contaminants. The success of the process is based on the fact that the rate constants for the reaction of the oOH radicals with most organic pollutants are very high. Hydroxyl radicals typically react a million to a billion times faster than chemical oxidants such as ozone or hydrogen peroxide.

When the reaction is complete, the contaminants have been converted into water, carbon dioxide, and, if the contaminant was chlorinated, residual chloride.

The Disinfection Process
Not long ago, it had been thought that very high doses of UV light were required to kill cryptosporidium, but Calgon Carbon Corporation's research discovered that low UV levels could be used to prevent the parasite from replicating. In October 2000, the Company was granted a U.S. patent for controlling cryptosporidium in drinking water using ultraviolet light.

Calgon Carbon's patented Sentinel™ System provides an effective barrier against viruses, bacteria and protozoa. UV disinfection is used to provide highly efficient inactivation of viruses, bacteria and protozoa — with no disinfection by-products.

Some advantages include:

- Low Cost — Medium-pressure UV technology achieves greater than 4 log inactivation / removal of cryptosporidium for less than 1 cent per 1,000 gallons
- Effective — Proven in full-scale testing
- Flexible Design — Can be retrofitted easily to existing systems
- Clean — No disinfection byproducts
- Safe — Fail-safe for operator safety

To learn more about the Sentinel™, view a PDF of our current advertising.

> Learn more about Calgon Carbon Corporation.

> Learn more about Cryptosporidium.

> Learn more about Giardia.

CALGON

CALGON CARBON CORPORATION

OPERATION AND MAINTENANCE MANUAL

SENTINEL™ UV DISINFECTION SYSTEM

8 X 4 KW

CALGON CARBON PROJECT NUMBER: US-03021.CCC5

PREPARED BY
CALGON CARBON CORPORATION
PITTSBURGH, PA

DATE: NOVEMBER, 2003

CALGON

CALGON CARBON CORPORATION

SECTION 2

SYSTEM OVERVIEW

CALGON
CALGON CARBON CORPORATION

SECTION 2
SYSTEM OVERVIEW

INTRODUCTION

Ultraviolet disinfection is used to destroy microbial contaminants in water. The Sentinel™ System is specifically designed for the disinfection of microbial contaminants such as *cryptosporidium parvum* in drinking waters.

Drawings Referenced

Control Panel
Equipment Layout
P & I D
Sentinel™ Reactor Assembly
System Component

SYSTEM FEATURES AND CAPABILITIES

Calgon Carbon Corporation has succeeded in developing UV disinfection equipment offering a wide range of features. Sentinel™ full scale equipment offers these features:

- High intensity medium pressure UV lamps which greatly reduce space and maintenance requirements
- Proprietary design of UV Reactors, including **Quickwipe™** automated quartz cleaning.
- Flexible, compact design with modular components to allow a high degree of flexibility in design for retrofitting into existing water plants with tight space requirements.
- Easy installation due to simple process and electrical connections.
- Automatic process control via a PLC for continuous process and safety monitoring.
- Minimal maintenance and operator requirements.

- Robust electromagnetic power supplies which are long lasting and stable
- UV sensor to ensure adequate UV dose is being applied.
- Isolated lamp power supply and control cabinet to ensure that electrical and control equipment can be placed in a safe and convenient location.
- Smart-start back-up lamp: a redundant back-up lamp will start automatically if one lamp extinguishes.

APPLICATIONS

The Sentinel™ System has a broad range of applications. It is effective at treating water contaminated by any one or mixtures of microbial contaminants, including:

- Cysts such as Cryptosporidium parvum and giardia
- Bacteria such as E-coli
- Viruses

BENEFITS

The Sentinel™ UV disinfection process has significant advantages over other methods of dealing with contaminated water:

- No harmful chemicals are added to the water
- No disinfection byproducts are produced
- Effective on all forms of microbiological organisms

FUNCTIONAL DESCRIPTION

This section is intended to introduce the reader to the Sentinel™ System and provide a general functional description of the system components.

The 6 x 4 kW unit consists of eight 4 kW Sentinel™ UV lamps housed in quartz tubes in a reactor with an accompanying control panel and Sentinel™ power supply.

Water is pumped through the reactor. The UV lamp irradiates the water as it flows through the reactor. Each of the nine quartz tubes is equipped with a transmittance controller, which cleans the quartz ensuring optimum transmittance of light to the water.

The unit is also designed to operate the lamps at reduced power. This is achieved through the operator interface. See Sentinel™ Operator Interface for more details.

When the tests are completed, the reactor can be drained through the drain valve at the bottom.

SYSTEM COMPONENTS

This section identifies all the major components of the Sentinel™ System (in alphabetical order) as shown in both the System Component and Equipment Layout drawings. A functional description of those components identified is also given. More details about some reactor components are given in the following sections. The next section, Section 3, describes system operation.

Control Panel

The module which provides supervisory control of the operation of the Sentinel™ System. Mounted on the Control Panel are various switches and an Operator Interface which allow the operator to adjust settings and to control equipment such as the UV lamps and transmittance controller. Located inside the Control Panel is a PLC (Programmable Logic Controller) which receives various input signals and determines if any alarm conditions arise. See section on Control Panel later in this chapter for more detail.

Drain Line

A line used to drain the Sentinel™ Reactor. A manual valve controls the draining.

Reactor Access Port

A port on side of the Sentinel™ Reactor for access into the reactor. A 6" removable plate covers the port and it is sealed by an O-ring and flanged connection.

Sentinel™ Power Supply

A high voltage power supply which powers the ultraviolet lamps inside the Sentinel™ Reactor.

Sentinel™ Reactor

A stainless steel vessel where disinfection of the water takes place. Within the Reactor are six 4 kW lamps which emits high intensity ultraviolet light for the destruction of contaminants.

Lamp Enclosure	Enclosed area on the front of the Sentinel™ Reactor to house the motor that drives the Transmittance Controller, the high voltage Lamp end connections and low voltage control connections.
Sample Port	A port with a hand valve where a water sample can be taken for analysis.
Temperature Switch	A temperature sensing element in the Reactor that activates if the water temperature exceeds 104 °F / 40 °C. An over temperature condition will prevent the lamps from operating.
UV Sensor	A instrument installed in the Sentinel™ Reactor used for sensing the amount of ultraviolet light emitting from the Lamp. There is one sensor per lamp. The percent output reading can be found on the Sentinel™ Operator Interface on the Control Panel.

SENTINEL™ REACTOR ASSEMBLY

This section presents a description of the Sentinel™ Reactor and its components. The Reactor is multi-lamp and the details below are for one UV Lamp and its components which are the same for all Lamps. Refer to the Sentinel™ Reactor Assembly drawing. The items are listed in alphabetical order.

Lamp End Housing Assembly	A stainless steel housing used to cap the side of the Reactor Chamber where a Lamp is located. The replacement of lamps and quartz is done by removing the cover to the housing. The cover is held in place with 4 cap screws.
Lamp Holder Assembly	A component which supports the Lamp in the center of the Quartz.
Moisture Sensor	A device located in the Lamp End Housing that will detect a leak in the quartz.
Reactor Chamber	A cylindrical stainless steel vessel for treatment of contaminated water. Housed in the Reactor Chamber are the ultraviolet Lamps.
Quartz Tube	Quartz sleeve that separates the UV Lamp from the water inside the Reactor Chamber. Quartz allows for the efficient transmission of ultraviolet light.

Quartz Tube Seal	An O-ring at either end of the Quartz Tube which provides the water seal at each end of the Quartz Tube.
Quartz Tube Seal Ring	A stainless steel ring which holds the Quartz Tube in place. The Quartz Tube Seal fits underneath the Quartz Tube Seal Ring.
Quartz Tube Seal Ring Bolts	A set of bolts which fasten the Quartz Tube Seal Ring to the reactor.
UV Lamp	A high power lamp tube which emits light in the ultraviolet spectrum into the water within the Reactor Chamber. The lamp has a lead wire on each end for the electrical connection.
Brush Motor Assembly	The motor, gear reducer and magnetic coupling that drive the quartz cleaning brushes (Transmittance Controller).

CONTROL PANEL	The Control Panel is the primary means by which the operator supervises the operation of the Sentinel™ System. Listed below in alphabetical order are the various switches and indicators on the Control Panel. Refer to the Control Panel drawing.
Emergency Stop Button	A pushbutton which, when pressed, will cause an immediate shut down of the Sentinel™ System. Power is immediately cut to the UV Lamps. The pushbutton must be twisted to be released.
Message Acknowledge Button	A push-button used to acknowledge alarm messages that are displayed on the Sentinel™ Operator Interface. This button silences the alarm buzzer.
Sentinel™ Operator Interface	An alphanumeric display which displays system status information such as flow rates or totalized flow, lamp power setting and lamp accumulated hours and transmittance controller cycles. It also displays alarm messages. See Section 6 for a detailed description of operation.
System Start Button	A push-button which, when pressed, initiates an automatic startup of the Sentinel™ System. The SYSTEM READY message must be displayed at the Message Display before the startup sequence can be initiated.

System Stop Button	A push-button which, when pushed, will cause an orderly shutdown of the Sentinel™ System.

SENTINEL™ POWER SUPPLY	The Sentinel™ Power Supply is a general purpose, ventilated electrical enclosure, suitable for dry, non-hazardous locations and it houses the UV Lamp power supplies. Each Lamp power supply is independent and operates under control of the Control Panel. The Sentinel™ Power Supply is able to run each lamp at full or reduced power which is controlled at the Operator Interface. Input power to the Sentinel™ Power Supply is specified in the External Wiring Diagram. The power supply has a disconnect handle that switches the incoming high voltage AC power. This handle can be locked-out when in the OFF position.

Partial List of Facilities Currently Using the Sentinel UV System

Sentinel® Installation List
July, 2005

Plant name: WSSC - Potomac WFP (Laurel, MD)
Peak Flow: 300 MGD
Equipment Model: (12) 9 X 20 kW Reactor
Reactor Size: 48"
Installation Date: 2006-2007
Status: Design
Surface Water

Plant name: Chetwynd Water Treatment Plant, BC, Canada
Peak Flow: .8 MGD
Equipment Model: (2) 3 X 4 kW Reactor
Reactor Size: 12"
Installation Date: Late 2005
Status: Design
Surface Water

Plant name: Trimark Communities Water Treatment Plant (Mountain House, CA)
Peak Flow: 5 MGD
Equipment Model: (2) 6 X 4 kW Reactor
Reactor Size: 18"
Installation Date: Mid-2005
Status: Delivered
Surface Water

Plant name: Trimark Communities Water Treatment Plant (Mountain House, CA)
Peak Flow: 15 MGD
Equipment Model: (2) 6 X 10 kW Reactor
Reactor Size: 36"
Installation Date: Mid-2006
Status: Delivered
Surface Water

Plant name: Cal Water (Bakersfield, CA)
Peak Flow: 2 MGD
Equipment Model: (1) 4 X 1 kW Reactor
Reactor Size: 12"
Installation Date: Mid-2006
Status: Delivered
Groundwater treatment non potable water

Plant name: Campbell River Water System, BC, Canada
Peak Flow: 20 MGD
Equipment Model: (2) 6 X 20 kW Reactor
Reactor Size: 48"
Installation Date: Late 2005
Status: Under Fabrication
Surface Water

Plant name: Rouse Hill RWP (Sydney Australia)
Peak Flow: 3 MGD
Equipment Model: (1) 8 X 4 kW Reactor
Reactor Size: 18"
Installation Date: Late 2005
Status: Under Fabrication
Wastewater Reuse

Plant name: Fena Water Treatment Plant (Guam)
Peak Flow: 15 MGD
Equipment Model: (2) 3 X 10 kW Reactor
Reactor Size: 36"
Installation Date: Late 2005
Status: Under Fabrication
Surface Water

Plant name: Deacon Booster Pump Station, Winnipeg, MB
Peak Flow: 206 MGD
Equipment Model: (6) 9 X 20 kW Reactor
Reactor Size: 48"
Installation Date: Installed
Status: Partially Operating
Surface Water

Plant name: City of Brandon WTP, MB
Peak Flow: 21.4 MGD
Equipment Model: (3) 8 X 4 kW Reactor
Reactor Size: 18"
Installation Date: Installed
Status: Operating
Surface Water

Plant name: Ft. Drum, Gouveneur, NY
Peak Flow: 3.6 MGD
Equipment Model: (1) 4 X 4 kW Reactor
Reactor Size: 18"
Installation Date: First Half, 2005
Status: Delivered, awaiting installation & commissioning

Surface Water

Plant name: City of Kelowna, B.C., Canada
Peak Flow: 48.8 MGD
Equipment Model: (3) 6 X 20 kW and (1) 4 X 4 kW Reactors
Reactor Size: 48"and 18"
Installation Date: Late 2005
Status: Delivered, awaiting installation & commissioning
Surface Water

Plant name: City of Kelowna, B.C., Canada
Peak Flow: 20 MGD
Equipment Model: (2) 6 X 20 kW
Reactor Size: 48"
Installation Date: Late 2006
Status: In production
Surface Water

Plant name: Orillia Water Filtration Plant (Orillia, Ontario)
Peak Flow: 11 MGD
Equipment model: (3) 8 X 4 kW reactors
Reactor size: 18"
Installation date: July 2005
Status: Under Installation
Surface Water

Plant name: Rossdale Water Treatment Plant, Edmonton, Alberta
Peak Flow: 79.3 MGD
Equipment model: (9) 3 X 10 kW reactors
Reactor size: 36"
Installation date: May 2004
Status: Operational
Surface Water

Plant name: Lac La Biche Water Treatment Plant, Lac La Biche, Alberta
Peak Flow: 4.4 MGD
Equipment model: (2) 8 X 4 kW reactors
Reactor size: 18"
Installation date: January 2004
Status: Operational
Surface Water

Plant name: Hulton Plant, Oakmont, PA
Peak Flow: 10 MGD
Equipment model: (2) 4 X 4 kW reactors
Reactor size: 24"

Installation date: April 2004
Status: Operational
Surface Water

Plant name: Louden County Sanitary, Leesburg, VA
Peak Flow: 12 MGD
Equipment model: 6 X 10 kW reactor
Reactor size: 36"
Installation date: July 2005
Status: Under Fabrication
Surface Water - reclaim water using Sentinel drinking water UV disinfection reactors

Plant name: Woolner Wells, ON (Regional Municipality of Waterloo ONT)
Peak Flow: 3 MGD
Equipment model: 6 X 4 kW reactor
Reactor size: 18"
Installation date: June 2003
Status: Operational
Ground Water

Plant name: Mannheim, ON (Regional Municipality of Waterloo ONT)
Peak Flow: 19.2 MGD
Equipment model: Two (2) 6 X 20 kW reactors
Reactor size: 48"
Installation date: February 2003
Status: Operational
Surface Water

Plant name: E.L. Smith Plant: Edmonton, AB
Peak Flow: 95 MGD
Average Flow: 45 MGD
Equipment Model: Three (3) 6 X 20 kW reactors
Reactor Size: 48"
Installation date: March of 2002
Status: Operational
Surface Water

Plant name: Canmore, AB
Peak Flow: 2.2 MGD
Equipment model: Two (2) 4 X 4 kW reactors (one redundant)
Reactor size: 24"
Installation date: March of 2002
Status: Operational
Surface Water

Plant name: Moon Township, PA
Peak Flow: 5.5 MGD
Average Flow: 3.3 MGD
Equipment model: Four 2 X 4 kW reactors
Reactor size: 12"
Water source: Ohio River
Installation date: 1st Quarter 2003
Status: Operational
Surface Water

Plant name: Bowling Green, Ohio
Peak Flow: 12 MGD
Average Flow: 5 MGD
Equipment model: 6 X 4 kW
Reactor size: 24"
Installation date: May 2000
Status: Operational
Surface Water

Plant name: West View Water, PA
Peak Flow: 40 MGD
Average Flow: 22 MGD
Equipment model: 6 X 20 kW
Reactor size: 48"
Installation date: March 2001
Status: Operational
Surface Water

Plant name: Grosse Pointe Farms, MI
Peak Flow: 14 MGD
Average Flow: 4.5 MGD
Equipment model: 6 X 4 kW
Reactor size: 24"
Installation date: May 2000
Status: Operational
Surface Water

Plant name: TSK, Japan
Average Flow: 1 MGD
Equipment model: 2 X 4 kW
Reactor size: 12"
Installation date: Feb. 2003
Status: Operational
Ground Water

Plant name: United Water, NY
Average Flow: 1 MGD
Equipment model: Two 4x1 kW
Reactor size: 12"
Installation date: Oct. 2002
Status: Operational
Ground Water

Plant Name : Frackville, PA
(Pennsylvania American Water Work Company)
Peak Flow: 1 MGD
Model: 4x1 kW
Reactor Size: 12"
Status: Operational
Surface Water

Attachment B

Attachment B

Alternatives to Address ABS Issues

High Desert Power Project, LLC (HDPP) is evaluating alternatives for water supply and aquifer banking at the HDPP facility located in Victorville, California. The HDPP facility is an 800-megawatt power plant that currently utilizes State Water Project (SWP) water from the California Aqueduct as the primary source of water for cooling and support of other plant processes. In general, the SWP water is adequate for the plant water requirements. However, during periods of drought or maintenance, the supply of SWP water may be interrupted with a negative impact on plant operation.

To address potential interruption in water supply, HDPP in conjunction with the Victor Valley Water District (VVWD) developed an Aquifer Banking System (ABS - also referred as ASR) to inject water into the aquifer for HDPP use in the event that SWP water is not available. To mitigate impact to the local groundwater, specific requirements were set forth in a Conditional Waiver issued by the Lahontan Regional Water Quality Control Board (LRWQCB) and Soil and Water Conditions issued by the California Energy Commission (CEC).

The ability to inject water has been significantly limited by higher than estimated TDS in the incoming State Water Project (SWP) water and extremely low annual average treatment levels for TDS and THM specified in the Conditional Waiver. As a result of high TDS levels and due to difficulties meeting the THM level, HDPP has discontinued injecting water several times over the last two years and the operation of the aquifer banking system (ABS) is likely limited to approximately three to four months per year. Injection during the summer is planned when TDS is historically lower in the SWP water than the rest of the year.

The aquifer banking system is the only backup source of water for HDPP and interruption of the ABS operation has the potential of rendering the project inoperable at a time when California needs a reliable source of electricity. To minimize the possibility of leaving the project without a reliable backup source of water, HDPP, in coordination with the CEC and other regulatory agencies, is evaluating several alternatives to expedite banking. The alternatives include:

- Using reclaimed water as a source of cooling tower water make up
- Using percolation ponds to recharge the aquifer
- Revising the ABS total volume injection requirements
- Revising the annual average treatment levels for TDS and THM
- Using an Reverse Osmosis (RO) system for periods of high TDS.

Below is a brief description of each alternative. The information in the following section is not the basis for this petition. It is included here to show only the alternatives currently being evaluated to expedite banking. A combination of the listed alternatives and/or actions may be necessary to address the current ABS issues.

1. Reclaimed Water

HDPP was recently approached by the Victor Valley Wastewater Reclamation Authority (VVWRA) and the City of Victorville regarding the use of reclaimed water at the HDPP facility. HDPP is actively pursuing this alternative with VVWRA and the City of Victorville. If and when this alternative is implemented, reclaimed water will be provided by VVWRA and purchased through the City of Victorville for use by HDPP as a source of cooling water. It will be added directly to the cooling tower and not into the pretreatment system used for aquifer recharge. The use of reclaimed water will result in a reduction of the amount of SWP water use and, consequently, a reduction in the amount of injection/recharge required through the ABS system. The use of reclaimed water will also reduce the amount of water needed from the aquifer during periods when the SWP water is not available (i.e., maintenance). A reduction in the amount of ABS injection will result in a reduction of salt loading to the aquifer.

The use of reclaimed water was explored by HDPP during the permitting phase of the project. However, the California Department of Fish and Game (DFG) determined that the reclaimed water was needed to maintain a riparian habitat, which extends north from the VVWRA treatment facility in Victorville, California to Bryman Road. Due to population growth over the last five years, the amount of reclaimed water available for industrial use has increased. A Memorandum of Understanding (MOU) between the DFG and the VVWRA established that 9,000 acre-feet per year (AF/yr), plus 20 percent of additional growth of treatment plant effluent will be discharged to the Mojave River. The MOU acknowledges that long-term decreases in reclaimed water discharges are not expected. Based on recent estimates, VVWRA is currently processing over 12,000 AF/yr of reclaimed water per year and approximately 2,000 AF/yr are now available to HDPP. Additional reclaimed water is expected to be available in the future due to population growth.

HDPP has met several times over the last two years with representatives of the CEC, the CDFG, the LRWQCB, MWA, City of Barstow, and City of Victorville regarding the use of reclaimed water by HDPP. All agencies fully support the use of reclaimed water by HDPP.

2. Percolation Ponds

Percolation ponds supplied with SWP water are being considered as an alternative method to ABS for recharging the aquifer. Percolation of raw SWP water eliminates concerns related to injecting water into the aquifer with TDS and THM levels above the current treatment limits.

If this alternative is implemented, the percolation ponds will be operated and maintained by the MWA as part of their plan to use ponds to recharge the aquifer. HDDP is considering providing assistance to the MWA (i.e., funding, technical, etc.) to facilitate the implementation of the percolation ponds project for aquifer recharge.

During informal discussions, the SWRCB has been receptive to the possible use of percolation ponds. The Mojave Water Agency (MWA) is authorized to recharge large volumes of water into local aquifers and the development of percolation ponds for HDPP will result in a very small increase in volume relative to the MWA recharge volumes.

3. Reduce Total Water Injection Volume

Per the CEC Decision, HDPP is required to inject 13,000 acre-feet (AF) into the aquifer over the first five years of commercial operation. The 13,000 AF injection requirement was based on a projected SWP water usage of 4,000 AF per year (AF/yr) for 3 years plus an additional 1,000 AF. The water usage of 4,000 AF/yr was the best estimate that could be made prior to commercial operation of HDPP.

Based on actual plant use and use of reclaimed water, HDPP plans to petition for reductions in the total injection volume as follows:

a) Reduce total injection volume from 13,000 AF to 10,000 AF based on reclaimed water use

Assuming that HDPP will use 1,000 AF/yr of reclaimed water, the annual SWP water use projection will be reduced to 3,000 AF per year and the projected three-year water use will be 9,000 AF. Adding 1,000 AF to this three-year projection results in a total net injection volume of 10,000 AF.

b) Reduce total injection from 10,000 AF to 7,000 AF based on use of actual plant water use

During the first two years of commercial operation, HDPP used approximately 3,000 AF/yr of SWP water. Based on plant operating projections the use of SWP water is predicted to be approximately the same amount for future years. Based on the actual plant water use and 1,000 AF/yr of reclaimed water, SWP water use will be reduced to 2,000 AF per year and the projected three-year water use will be 6,000 AF. Adding 1,000 AF to the three-year use projection results in a total injection volume of 7,000 AF.

4. Revise Annual Average Treatment Levels for TDS and THM

a) <u>Increase the Annual Average Treatment Level for TDS from 248 mg/L to 322 mg/L</u>

The increase in the annual average TDS would provide HDPP with the opportunity to inject water on a more consistent basis without a negative impact on the groundwater quality. The current annual average treatment level in the LRWQCB Conditional Waiver for TDS is 248 mg/L, with a maximum of 400 mg/L. HDPP is proposing to increase the annual average treatment level from 248 mg/L to 322 mg/L and maintaining the current maximum level of 400 mg/L. The calculation of this TDS annual average treatment level is based on incoming SWP water quality, addition of solids during the treatment process, and a safety margin covering both normal and drought periods. The treatment level in the Conditional Waiver of 248 mg/L was based on a five year average of SWP water of 233 mg/L and 15 mg/L from treatment chemicals. The average TDS in SWP water as measured at Check 41 from 1989 to 2004 was 271 mg/L. A higher level of chemical treatment has been required to meet the turbidity specification in the effluent of the Actiflo clarifier. The average TDS increase in water treated in the ABS system from addition of the ferrous sulfate coagulant has been 22.5 mg/L, The average TDS in the ABS under these conditions would be approximately 293.5 mg/L. Applying a ten percent margin to accommodate a higher TDS in drought years, the average annual average TDS for injected water would be 322 mg/L.

For comparison, the LRWQCB recently issued a Conditional Waiver to the County of Los Angeles Department of Publics Works Lancaster Sub-Basin Project in October 2004. The waiver states that treated water injected into the ground waters of the Antelope Valley Groundwater Basin shall not exceed 350 mg/L and does not require an annual average treatment level. Injection of treated SWP water would occur over a five month period with extraction during the remaining seven months of the year. The maximum injection for a given year is 6,843 acre-feet. With a TDS concentration of 350 mg/L, approximately 6.5 million pounds of dissolved solids would be added to the aquifer per year. Though more water could be extracted each year, up to 13,282 acre-feet, dissolved solids in the aquifer in close proximity to the injection wells would be higher than the 140 mg/L background concentration.

Based on 85 % capacity factor (2,947 acre-feet) and a proposed average TDS level of 322 mg/L the annual dissolved solids loading to the aquifer would be 2.57 million pounds. Water injected by HDPP @ 322 mg/L TDS is only 40% of the dissolved solids loading compared to that allowed to County of Los Angeles Department of Public Works.

The estimated background TDS concentration in the vicinity of the HDPP ABS injection wells is 165 mg/l. The estimated background TDS concentration in the vicinity of the Antelope Valley injection system ranges from 100 mg/l to 225 mg/l. Since the background TDS concentrations are similar, HDPP believes that it is appropriate for the TDS treatment levels to be similar.

b) **Increase the Annual Average Treatment Level for Total Trihalomethanes (THM) from 0.5 ug/L to 2 ug/L**

NOTE: HDPP will continue pursuing the increase to the annual average treatment level for THM since the UV system has not been approved for installation and use at this time.

The current annual average treatment level in the LRWQCB Conditional Waiver for total trihalomethanes is 0.5 ug/L, with a maximum of 5 ug/L. The annual average does not allow for the presence of any detectable THM in the injected water. A single THM result of 5 ug/L would result in exceeding the annual average treatment level even if all the remaining months were below the analytical detection limit of 0.5 ug/L. The average calculation requires a concentration of 0.25 ug/L be used for monthly results at or below the method detection limit. In order to maintain cleanliness of the injection piping system and the absence of coliform bacteria a small amount of chloramines injection is required. Chloramines react with organic matter in the treated SWP water to form trihalomethanes. A study conducted in 2003 by McGuire Environmental Consultants Associates using SWP water processed through an ultrafiltration system and injected with 0.5 mg/L chloramines indicated the presence of low level THM, typically below 2 ug/L. During the early months in 2004, THM analyses of SWP water treated through the ABS process at HDPP showed the presence of THM concentrations between 0.5 and 2.0 ug/L.

The annual average for THM should be increased from 0.5 ug/L to 2 ug/L to allow the addition of chloramines to maintain cleanliness of the ABS injection system. The proposed treatment level is based upon the laboratory evaluation and actual injection data. The laboratory study used SWP water that was passed through an UF cartridge and injected with approximately 0.5 mg/L of chloramines showed an average THM of 2.0 ug/L. Data collected from the ABS system during the first three years of operation has shown values from nondetectable, 0.5 ug/L, to a maximum of 3.1 ug/L. THM formation has been highly variable though the chloramines feed has been maintained at low levels (0.1 to 0.4 mg/L). The proposed treatment level of 2.0 ug/L was determined by taking an average of the minimum and maximum values plus a ten percent margin (1.8 times 1.1).

The proposed treatment level is well bellow the drinking water standard of 80 ug/L for THM. The Conditional Waiver issued by the LRWQCB to the County of Los Angeles Department of Publics Works Lancaster Sub-Basin Project in October 2004 allows the Project to inject treated water to have a running monthly average of 40 ug/L with a maximum of 72 ug/L. The annual average and maximum are 80 times and 14 times less restrictive, respectively than the current treatment levels stipulated for the HDPP groundwater injection. Though the County of Los Angeles Project can extract the high THM injected water for seven months of the year, the THM concentration near the injection wells will be significantly elevated during the five month injection period.

5. Reverse Osmosis (RO) System

The following is brief explanation of how the reverse osmosis (RO) system operates and will lower TDS when the level in the incoming water is high.

A RO system utilizes a semi-permeable membrane to separate undesirable materials (dissolved solids in this case) from the desirable materials (water in this case). The membranes are designed to allow certain materials to pass through and reject others. This is accomplished by properly sizing the pores (holes) in the membrane during the manufacturing process. In this case, the design will allow water to pass through, but not dissolved solids. The membrane does not allow dissolved solids to pass through because the molecules are too large to fit through the pores in the membrane. The system uses a pump to ensure that the osmotic pressure is overcome so that the water passes through the membrane.

A RO system that can be used for this process will produce 200 gallons per minute (gpm) of water and operates at approximately 75% recovery of the inlet flow. A standard system consists of two sets of modules installed in a 3 x 2 x1 array in twelve housings for a total of 72 membrane modules. The reject stream from the first stage is the feed to the second stage and the reject from the second stage is the feed to the third. The permeate (water allowed through the membrane) is combined from all three stages. A feed of 266 gpm produces a product flow of 200 gpm with a reject rate of 66 gpm of reject water. The rejection rate of TDS is approximately 90 to 95%. The reject stream has a concentration of TDS about four times that of the incoming stream. The process uses a booster pump to overcome the osmotic pressure and forces water through the semi-permeable membrane while concentrating the salts in a reject stream. As an example: if the incoming water contained 300 mg/L of TDS, the permeate or product stream would contain 15 to 20 mg/L while the reject would contain about 1,200 mg/L.

Pretreatment may be required that consists of acid feed to lower the pH to 6-6.5 and may also require antiscalant to prevent calcium carbonate deposition.

A side stream (200 gpm) RO would allow approximately 10% increase in incoming water TDS to be treated. The drawback with the RO is where the reject stream could go if the plant is not running. It would take approximately 75 hours to completely fill up the clarified water tank if it was empty. The additional salt loading will increase the amount of blowdown from the cooling tower that must be treated by the ZLD system.

Attachment C

Attachment C

Schedule To Complete Evaluation of Alternatives to Address Current Aquifer Banking System Issues at the High Desert Power Project

Reclaimed Water

Task	Expected Completion Date
Evaluate feasibility of using reclaimed water.	Evaluation has been completed. HDPP has met several times over the last two years with representatives of the CEC, the CDFG, the LRWQCB, MWA, City of Barstow, and City of Victorville regarding the use of reclaimed water by HDPP. All agencies fully support the use of reclaimed water by HDPP. HDPP is currently working on the all applications, agreements, engineering design, etc. for the implementation of this alternative. Petition for approval to use of reclaimed water will be submitted during the second quarter of 2006.

Percolation Ponds

Task	Expected Completion Date
Evaluate technical and economic feasibility of this alternative.	July 1, 2006
Prepare detailed description of alternative and present to major stakeholders and obtain agreement.	August 1, 2006 MWA informally presented the alternative to all stakeholders.

Revisions to ABS Total Volume Injection Requirements

Task	Expected Completion Date
Evaluate feasibility of revising alternative.	Evaluation completed.

	Application for approval of revisions will be submitted along with the petition for the use of reclaimed water. It will be submitted during the second quarter of 2006.

Revisions to Annual Average Treatment Levels for TDS and THM

Task	Expected Completion Date
Evaluate feasibility of revising the annual average treatment levels for TDS and THM including potential impact to the aquifer.	Evaluation has been completed. Preliminary modeling results show insignificant impact to the aquifer and no impact to the VVWD wells. HDPP is currently working on the application for revisions to the treatment levels. It will be submitted to the LRWQCB, CEC and others by April 1, 2006.

Reverse Osmosis (RO) System

Task	Expected Completion Date
Evaluate technical and economic feasibility of using an RO system to treat a fraction of the SWP incoming water.	May 1, 2006